MESOZOIC INSECTS OF QUEENSLAND.

No. 7. Hemiptera Homoptera; with a Note on the Phylogeny of the Suborder.

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(With Twenty-four Text-figures.)

The first collection of fossil insects made by Mr. Dunstan at Ipswich contained only a single Hemipteron belonging to the Suborder Homoptera. This specimen I named *Mesojassus ipsviciensis* (8, p. 35, Pl. 2, fig. 7), placing it in the family *Jassidae*. In the two consignments following, no less than twenty-two specimens of Homoptera are represented, some of them in a very perfect state of preservation. Thus this group now becomes next in importance to the Coleoptera, as regards its numerical preponderance in the Ipswich Insect Fauna; and the working out of the material has been a matter of considerable interest on this account, as well as on account of the beauty and remarkable preservation of some of the forms.

In writing this paper, I have been fortunate in having had the advice and criticism of Mr. F. Muir, F.E.S., of Honolulu. Mr. Muir is a recognised authority upon the Homoptera, and I desire to thank him for reading the MS. and offering some valuable criticisms.

All the material consists of tegmina, either whole or in fragments. The toughness of the Homopterous tegmen renders it, like the elytron of the Coleoptera, particularly suitable for preservation in the fossil state; whereas the hindwing is, in most families, so delicate that it is not surprising that it is seldom found. Further, owing to the fact that the tegmen is divided obliquely by a deeply impressed furrow along the vein Cu_2, it is particularly liable to split along this vein; so that many of the fossils consist either of the main portion of the wing lying an-

terior to this furrow, or only of the *clavus,* or anal area, lying posterior to it. This clavus is only a small part of the wing, with nothing but the anal veins preserved upon it; and yet, as we shall see in the course of this paper, every clavus discovered by itself should be preserved and described, because there is on the clavus, at least one character of great importance for the correct classification of the fossil forms.

The oldest known Homoptera are three forms from the Upper Permian, viz. *Scytinoptera kokeni* Handl. (3, p. 392) from the Kama River, Russia, *Permoscarta mitchelli* Till. (9, p. 728) from Newcastle, N.S.W., and *Permofulgor belmontensis* Till. (9, p. 731) from Belmont, near Newcastle, N.S.W. Handlirsch places *Scytinoptera* in a distinct Order Palæohemiptera; but I have already expressed my opinion that this is nothing more nor less than a true Homopteron (10, p. 587). *Permofulgor,* as a very distinct type unlike anything existing to-day, was put into a new family *Permofulgoridae. Permoscarta* I placed in the *Cercopidae;* but, on maturer consideration, I think it should be removed to the *Scytinopteridae.*

From the Upper Trias only two Homoptera are so far known. One of these is *Mesojassus ipsviciensis* Till., already mentioned; the other *Triassopsylla plecioides* Till. (9, p. 754) from the Wianamatta Shale of Glenlee, N.S.W.

Handlirsch lists no less than twenty-two species of Homoptera from the Lias, and there are undoubtedly others from various localities in England, which have not been properly described as yet. The named species come from England, Switzerland and Germany, the most prolific locality being Dobbertin in Mecklenburg, with seventeen species. They are placed as follows:— *Fulgoridae,* 4 genera, 13 species; *Procercopidae,* 1 genus, 3 species; *Jassidae,* 1 genus, 5 species; *Archipsyllidae,* 1 genus, 1 species.

Thus it will be seen that the Ipswich beds have already yielded an Homopterous fauna as rich as any yet found in the Palaeozoic or Mesozoic epochs; and it may reasonably be hoped that many more may be discovered later on. That being so, it is of especial importance that these fossils should be most carefully studied, in the hopes that they may throw some light upon the Phylogeny of the Homoptera.

Here we meet with the initial difficulty that the classification of the Homoptera is based for the most part upon characters

other than the wing-venation; such as, for instance, the number and position of the ocelli, the form of the legs and prothorax, and the shape of the head. Recent studies of the nymphal tracheation in the various families have much improved our knowledge of the venation, but they have not yielded a really satisfactory basis of classification on venational characters only.

In this connection, I should like to point out that the vein which has been interpreted by Comstock and his school (1, 2, 4, 5, 6) as 1A in the Homoptera is certainly not that vein, but Cu_2. Its precedent trachea comes off from Cu, not far from its origin, in all families of the Homoptera, and in all instars in which the wing-sheaths are developed far enough for examination. This condition is exactly parallel with that to be found in all instars of the Cockroaches, in which I have recently satisfied myself that the *vena dividens,* or concave vein separating the anal area from the rest of the wing, is undoubtedly Cu_2; and, as this vein also borders the clavus or anal area in the Homoptera, there is no longer any need for a far-fetched attempt to name it 1A, by trying to explain that its trachea has become fused with Cu. The condition shown in the Homoptera and the Cockroaches is also exactly the same as that seen in the Panorpoid Orders, in which I have already shown (11) that Comstock makes the same mistake in working out the venation of the Trichoptera and Lepidoptera, though he has got the names of the veins right in the Megaloptera, and thereby himself admitted his error in the other Orders. I have also, finally, studied the venation in all examinable stages of the Psocoptera, in which this same condition is also to be found. The only conclusion to be come to is that the cubitus in all these groups is normally three-branched, Cu_1 forking distally into Cu_{1a} and Cu_{1b}, while Cu_2 is a straight, concave vein, which, in those Orders which have a separate clavus, borders that area anteriorly. I have therefore marked the *vena dividens,* in all my figures, as Cu_2; in this respect, my nomenclature for the Homoptera differs from all the figures of the venation of this Order so far published except Muir's (7).

It follows from this that the veins on the clavus itself are 1A and 2A. Vein 3A is absent in all recent forms, but is clearly to be seen in the Permian genus *Permofulgor* (9), and in the Liassic genus *Archijassus* (3).

In working out the Ipswich fossil Homoptera, it is at once

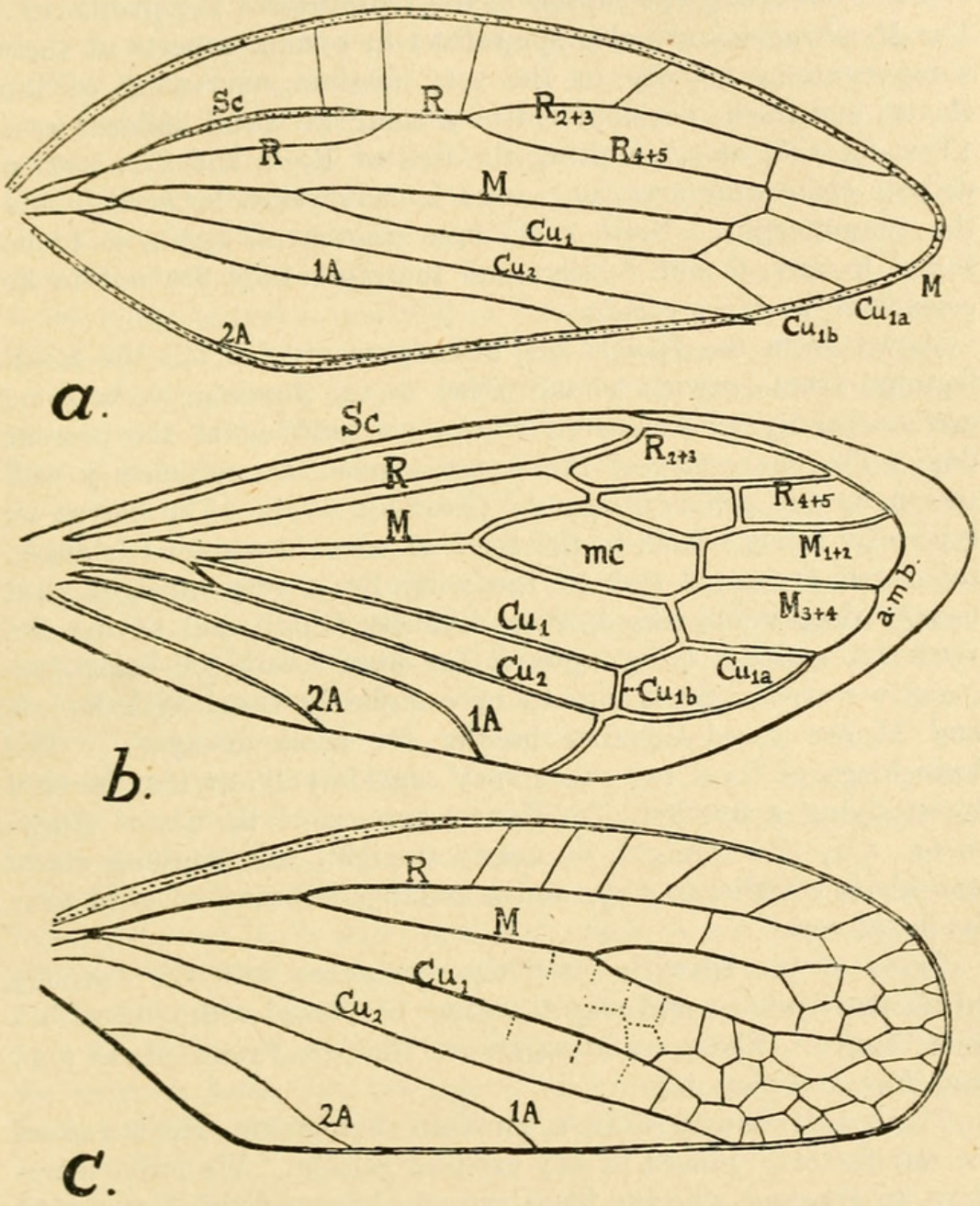
evident that they all belong to the division Auchenorrhyncha, comprising, at the present time, only the families *Cicadidae, Cercopidae, Jassidae, Membracidae* and the old family *Fulgoridae,* this last being now usually split up into seven or more families (Fulgoroidea). Further than this we may also say that the *Cicadidae* are not represented in the collection under review. Their type of venation is very distinct; and nothing approaching it has been found at Ipswich, with the single exception of the puzzling genus *Mesogereon,* which has been allotted a special part of this work to itself, seeing that it constitutes a very special problem involving the discussion of other Orders as well. There remain, then, only the other families of the Auchenorrhyncha in question; and hence we have to determine, as far as possible, what are the venational differences to be considered in separating one family from another, and thus in placing our fossils in their correct families.

First of all, the old family *Fulgoridae* contained, with very few exceptions, insects in which the clavus of the tegmen had the two veins 1A and 2A united together for a greater or less distance distally, to form a true Y-vein, of the same type that I have already discussed in the Lepidoptera (11). We may, then, take it that any Fulgoroid fossils would have this character. It is only present in a single genus of the fossils, viz. *Ipsvicia.* As these tegmina are very distinct from anything known at the present day, I have placed them together in a new family *Ipsviciidae,* belonging to the superfamily Fulgoroidea.

The *Cercopidae, Jassidae* and *Membracidae* all agree in having tegmina in which 1A and 2A remain apart from one another. This character is clearly shown in all the remaining tegmina in which the clavus is preserved. In separating the remaining fossils, therefore, we have to consider the venation of the rest of the tegmen more carefully.

In Text-fig. 1, I have shown the venation of an Australian genus *Cercopidae, Philagra* (*a*), of an Australian Membracid genus *Sertorius* (*b*), and an archaic Australian Jassid genus, *Eurymela* (*c*).

In all *Cercopidae* which I have seen, as in *Philagra* here figured, veins Sc and R are distinct and separate for a considerable distance basally, and then become united. We may take it, therefore, that this character should appear in any fossil tegmina that are to be considered true *Cercopidae.* As it is not present in



Text-fig. 1.

Venations of tegmina of recent *Cercopidae*, *Membracidae* and *Jassidae*. *a*, *Philagra* sp. *(Cercopidae)* from Mount Tambourine. Q. *b*, *Sertorius* sp. *(Membracidae)* from Jervis Bay, N.S.W. *c*, *Eurymela* sp. *(Jassidae)* from Gosford, N.S.W. For lettering see p.895.

any of our fossils, we may decide that they are not members of this family.

The *Jassidae* and *Membracidae* are very closely allied. The two families probably arose from a common stem, the *Mem-*

bracidae becoming specialised in the sculpture of the prothorax. The *Membracidae* are also specialised in certain aspects of their wing-venation, notably in the very distinct narrowing of the clavus, and in the development of a complete distal *ambient vein* (Text-fig 1 *b, amb.*), uniting the tips of R, M and Cu; with a definite clear wing-area, uncrossed by any veins, between it and the wing-margin. Neither of these characters, again, is to be found in any of our fossils; and therefore they are not to be considered as *Membracidae.*

Apart from the *Ipsviciidae,* already mentioned, all the fossil tegmina from Ipswich belong either to the *Jassidae,* or to some archaic family of Auchenorrhyncha not existing at the present day. The characters of the Jassid tegmen are sufficiently well shown by the genus *Eurymela* (Text-fig. 1 *c*). The clavus is, typically, fairly broad, in the form of an obtuse-angled triangle, separated from the rest of the wing by a very straight, and usually deeply impressed, vena dividens (Cu_2), and having the veins 1A and 2A lying upon it far apart, vein 2A being frequently waved. Sc is absent, or completely fused with R. R and M are fused together basally for some distance. The branchings of these two veins vary considerably, as may be seen by studying a number of different species of the genus *Eurymela.* Cu_1 is a straight, or nearly straight, vein running above and about parallel to Cu_2, and remaining unbranched until near its distal end.

Three of the Ipswich fossil tegmina agree with the *Jassidae* in all these points, and may therefore be placed definitely within that family. These are *Mesojassus* Till. (8), *Triassojassus* n.g., and *Eurymelidium* n.g.

There still remain over a number of tegmina which cannot be satisfactorily placed in any existing family. We have, therefore, to consider whether there are any known fossil forms with which they show affinity. The fossil forms already known in the Homoptera, which do not belong to existing families, are the Liassic family *Procercopidae* of Handlirsch, and the Permian genus *Scytinoptera* Handlirsch. The venation of the former is that of the true *Cercopidae.* Handlirsch only placed them in a separate family because he was of opinion that true *Cercopidae* could not have existed in the Lias. They may, therefore, be dismissed from the question. With respect to *Scytinoptera,* which comes from the Upper Permian of the Kama River, Rus-

sia, Handlirsch placed this fossil, together with the genus *Prosbole,* in a new Order Palaeohemiptera, and formed, for the reception of this single fossil, the new family *Scytinopteridae.* I have already discussed the genus *Prosbole* in connection with the Triassic *Dunstaniidae* from the Ipswich Beds, and have, in the same place, given it as my opinion that *Scytinoptera* is a true Homopteron (10). A survey of the new Ipswich Homoptera now shows that this opinion is correct. For there can be no doubt that the forms included in this part are true Homoptera, all of them having the tough, leathery consistency of the tegmen so frequently found in the Suborder, with distinct separation of a claval area along a straight vena dividens, and also definitely Homopteroid venations. And when we come to compare the venation of *Scytinoptera* with that of those Ipswich fossils which we have not so far been able to place, we are struck at once with the close similarity between this Permian genus and two of the Ipswich forms, which I have placed in a new genus *Mesoscytina.* These forms are undoubtedly closely related to *Scytinoptera,* and should go into the same family. I have, therefore, no hesitation in removing *Scytinoptera* from the Palaeohemiptera to the true Homoptera, and in constituting the family *Scytinopteridae* to contain the most archaic venational types of Homoptera yet discovered.

The *Scytinopteridae* are distinguished at once by the lack of fusion between R, M and Cu basally, there being instead, generally, a very peculiar formation at the base of these three veins, which is well shown in the genus *Scytinoptera* itself (Text-fig. 4). It would appear that three veins start out separately from the extreme base, and then come together again at a point a little further on. This same formation is to be seen in the *Ipsviciidae.*

Apart from this, the *Scytinopteridae* have the veins R, M and Cu separate, and diverging from one another from near the base outwards. In the original genus *Scytinoptera,* the clavus was not preserved. In one of the two species of *Mesoscytina,* n.g., described in this paper, a considerable portion of the claval area is preserved. From this we can see that the anal angle was somewhat rounded, not obtuse-angled as in the *Jassidae,* and that 1A and 2A are of very primitive form, and lie far apart from one another. In another new genus from Ipswich, *Mesodiphthera,* in which only the basal half of the tegmen is pre-

served, the whole of the clavus is present, showing complete agreement with that of *Mesoscytina,* as far as the latter is preserved. We may therefore place *Mesodiphthera* also in the *Scytinopteridae.*

Mesodiphthera n.g. differs from the rest of the *Scytinopteridae* so far mentioned, in that R branches into two at about the same level as the fork of M; whereas, in the other genera, R remains unbranched until near the apex of the wing. This gives us at once a connection with the Permian genus *Permoscarta* Till., (9, p. 727) from the Newcastle Beds. Originally, I placed this genus in the *Cercopidae;* but more mature study has convinced me that this type is far too generalised to go definitely into any existing family; and I now take the opportunity of removing it to the *Scytinopteridae,* as constituted in this paper. At the same time, we may reconsider the position of the genus *Permofulgor* (9, p. 730) from the Belmont Beds. For this genus, I made a new family *Permofulgoridae.* With the widening of the definition of the family *Scytinopteridae,* it is now evident that the *Permofulgoridae* are only a subfamily within that family; and, as Handlirsch's generic name *Scytinoptera* is older than my *Permofulgor* I now propose to sink the *Permofulgoridae* definitely to the status of a subfamily *Permofulgorinae,* within the *Scytinopteridae.*

It will thus be seen that all the known Permian Homoptera now go into the one family *Scytinopteridae;* and this affords additional proof, if such were now needed, of the Upper Permian age of the Upper Coal Measures of the Newcastle district.

Four more genera still remain to be placed, amongst the Ipswich fossils dealt with in this paper. Of these, *Chiliocycla* is a well defined genus, remarkable for the exceptionally strong and specialised tuberculation of the basal two-thirds of the wing. Its venation, so far as preserved, is closely allied to that of both *Scytinoptera* and *Mesoscytina,* and thus it may most certainly be placed within the *Scytinopteridae.* Another genus, *Triassoscarta,* n.g. shows distinct affinity with *Permoscarta* Till. from the Newcastle Beds, and, through this genus, with *Mesodiphthera;* this also can therefore be placed in the same family. The remaining two genera differ from all the rest in having three branches to R, and thus have a venation which, though definitely Scytinopterous in other respects, also resembles that of the *Cixiidae* amongst the Fulgoroidea. As, however, amongst the

many claval areas preserved at Ipswich, none but those of the highly specialised *Willcoxiidae* are of the Fulgoroid type, it would seem fairly certain that these two fossils may not be classed with the Fulgoroidea. They are better regarded as belonging to a separate subfamily of the *Scytinopteridae,* from which, perhaps, the *Cixiidae* arose later on, by specialisation of the veins of the clavus. I propose to name this subfamily the *Mesocixiinae,* from the name of the best preserved of the two genera, *Mesocixius,* n.g.; the other genus is *Triassocixius,* n.g.

We may now sum up the above results as follows:—

(1) In the Upper Permian, both in Russia and Australia, the first true Homoptera were present in the form of a single family having very primitive venational characters, viz. the *Scytinopteridae,* represented by the three genera *Scytinoptera* Handl. (Kama River, Russia), *Permoscarta* Till. (Newcastle, N.S.W.) and *Permofulgor* (Belmont, N.S.W.).

(2) In the Upper Trias of Ipswich, the *Scytinopteridae* were still the dominant family of Homoptera, being represented by no less than six genera. The *Ipsviciidae* were a highly specialised offshoot from this ancient family. Nothing like them is known elsewhere, either fossil or recent. Amongst recent families, the *Jassidae* were present at Ipswich, and represented by three genera. Other existing families were not represented at Ipswich, so far as known.

(3) In the Lias of the Northern Hemisphere, true *Scytinopteridae* appear to have become extinct. True Fulgoroids, Jassids and also Cercopids (Handlirsch's *Procercopidae*) were present.

It is interesting to note that, at Ipswich in the Upper Trias, the Homoptera formed nearly 20 per cent. of the total insect fauna, as preserved in the fossils, while at Belmont and Newcastle (calculated on a much smaller number of preserved forms) they formed 50 per cent. In the Lias, the Homoptera were only 6.6 per cent. of the total insect fauna. This percentage decreased to 4.5 in the Tertiary, and to 3.6 at the present day. The drop in the percentage from the Ipswich Trias to the Lias is due in part to the dying out of the *Scytinopteridae,* but more to the great rise in the representation of other Orders. If further evidence were needed of the approximate age of the Ipswich Beds, the percentage of Homoptera would place them definitely between the Upper Permian of Newcastle and the Lias of the Northern Hemisphere, but somewhat closer to the latter than to the former.

We may now proceed to the classification and description of the Ipswich fossil Homoptera. For this purpose, I offer first of all a list of the fossils, arranged in their families, and will then take each family in turn, and give keys to the subfamilies and genera included in it.

LIST OF THE FOSSIL HOMOPTERA FOUND AT IPSWICH.

Family SCYTINOPTERIDAE Handl.

Genus CHILIOCYCLA, n.g. (Genotype, *Ch. scolopoides*, n. sp.)
1. *Chiliocycla scolopoides*, n. sp. (p. 869).

Genus MESOSCYTINA, n.g. (Genotype, *M. australis*, n. sp.)
2. *Mesoscytina australis*, n. sp. (p. 871).
3. *Mesoscytina affinis*, n. sp. (p. 872).

Genus MESODIPHTHERA, n.g. (Genotype, *M. grandis*, n. sp.)
4. *Mesodiphthera grandis*, n. sp. (p. 873).

Genus TRIASSOSCARTA, n.g. (Genotype, *T. subcostalis*, n. sp.)
5. *Triassoscarta subcostalis*, n. sp. (p. 874).

Genus MESOCIXIUS, n.g. (Genotype, *M. triassicus*, n. sp.)
6. *Mesocixius triassicus*, n. sp. (p. 877).

Genus TRIASSOCIXIUS, n.g. (Genotype, *Tr. australicus*, n. sp.)
7. *Triassocixius australicus*, n. sp. (p. 878).

Family IPSVICIIDAE, fam. nov.

Genus IPSVICIA, n.g. (Genotype, *I. jonesi*, n. sp.)
8. *Ipsvicia jonesi*, n. sp. (p. 879).
9. *Ipsvicia maculata*, n. sp. (p. 881).
10. *Ipsvicia acutipennis*, n. sp. (p. 883).

Family JASSIDAE.

Genus EURYMELIDIUM, n.g. (Genotype, *E. australe*, n. sp.
11. *Eurymelidium australe*, n. sp. (p. 885).

Genus MESOJASSUS, Till. (Genotype, *M. ipsviciensis* Till.)
12. *Mesojassus ipsviciensis* Till. (p. 886).

Genus TRIASSOJASSUS, n.g. (Genotype, *Tr. proavitus*, n. sp.)
13. *Triassojassus proavitus*, n. sp. (p. 888).

Besides the above, there are five good impressions of Homopterous clavi, which I have decided to figure and describe, though they cannot be named.

There are also five other impressions of Homopterous tegmina which are too fragmentary or indistinct to be either described or figured. The total number of Homoptera so far found at Ipswich is therefore twenty-two specimens.

Family SCYTINOPTERIDAE Handl., a me emendata.

Primitive Homoptera belonging to the Upper Permian and Trias, in which the veins R, M and Cu come off separately from a point close to the base, and diverge from one another distad. Sc may or may not be present as a separate vein. M and Cu_1 are always forked, the former usually, the latter always towards the distal part of the wing. Condition of R very variable.

Clavus separated from rest of wing by a straight, deeply impressed vena dividens (Cu_2). Veins of the clavus (1A, 2A), standing far apart, 1A being waved, 2A very short, 3A usually absent. Anal angle rounded.

Tegmina of a tough, leathery consistency, finely tuberculated or pitted all over in most genera, but sometimes (*Chiliocycla*) armoured with large, closely-set, circular, flat tubercles, or quite smooth (*Permofulgor*).

Key to the Subfamilies and Genera of the family SCYTINOPTERIDAE.

(1) Tegmen very narrow and elongated, smooth; clavus with three separate veins upon it. ——————Subfam. PERMOFULGORINAE. (Only one genus, PERMOFULGOR Till. from the Upper Permian of Belmont, N.S.W.)

Tegmen much broader in proportion, more or less tuberculated or pitted; clavus with only two separate anal veins, placed wide apart. ——————2.

(2) R with only two main branches, or not branched at all until near distal end. ——————Subfam. SCYTINOPTERINAE. 3. (Upper Permian and Upper Triassic).

R dividing into at least three main branches (venation of distinct Cixiid type). ——————Subfam. MESOCIXIINAE. 8. (Upper Trias of Ipswich, Q.)

(3) Basal two-thirds or more of tegmen covered with large, flat, circular tubercles, closely set together. ——————CHILIOCYCLA, n.g.

No such tubercles present on tegmen. ——————4.

(4) Area of tegmen between costa and R free of transverse veinlets from base to beyond half-way along the wing. ——————5.

Area of tegmen between costa and R with a series of transverse veinlets beginning before half-way. ——————7.

(5) M remains unbranched except at its distal end. ——————SCYTINOPTERA Handl. (Upper Permian of Kama River, Russia).

M branching into two at or before middle of wing. ——————6.

(6) R remains unbranched until well beyond half-way along the wing. ——————Mesoscytina, n.g.

R branches into two slightly before the level of the branching of M. ——————Mesodiphthera, n.g.

(7) R unbranched; the series of veinlets between it and the costa extending from base to apex. ——————Triassoscarta, n.g.

R branched just before half-way; the veinlets between it and the costa beginning just beyond the dichotomy of R, and continuing to the apex, with a series of cross-veins beneath them, between the two branches of R. ——————Permoscarta Till. (Upper Permian of Newcastle, N.S.W.)

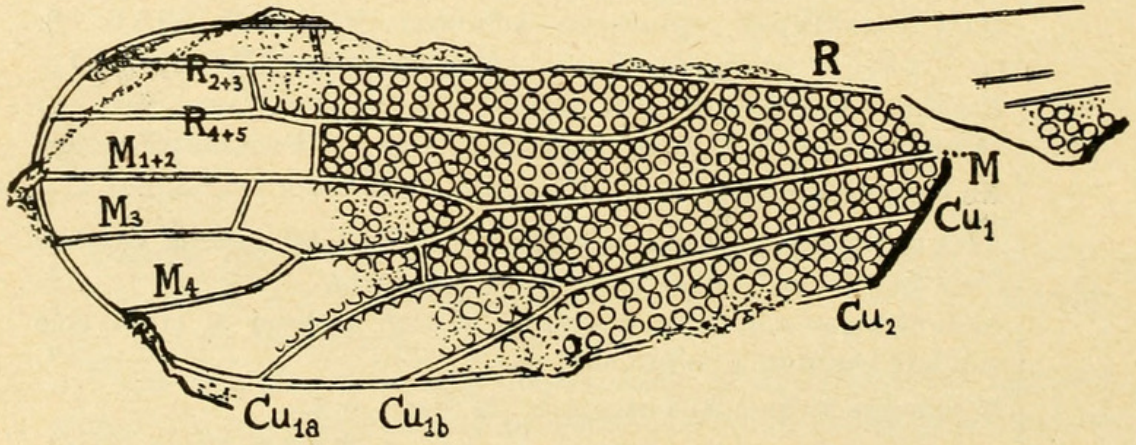
(8) First dichotomy of R placed closer to the origin of R from M than to the second dichotomy of R; only two veinlets from the most anterior branch of R to the costa. ——————Mesocixius, n.g.

First dichotomy of R much closer to second dichotomy than to the origin of R; a series of parallel veinlets from the most anterior branch of R to the costa. ——————Triassocixius, n.g.

Subfamily SCYTINOPTERINAE.

Genus Chiliocycla, n.g. (Text-fig. 2).

Basal two-thirds or more of the tegmen covered with a remarkably strong sculpture of small, flat, circular tubercles set closely together. R with a single posterior branch arising a little before half-way; this branch connected to M_{1+2} by a single cross-vein above the median cell. M branches dichotomously at a level only slightly nearer to the base than the apical end of the clavus; the lower branch of M again divides, and the median cell is closed by a cross-vein from M_{1+2} to M_3. Cu_1



Text-fig.2.

Chiliocycla scolopoides, n.g. et sp. (x 15). For lettering see p.895.

a straight vein with a strong distal fork; a cross-vein connects Cu_{1a} with the median cell above it. (Clavus not preserved).

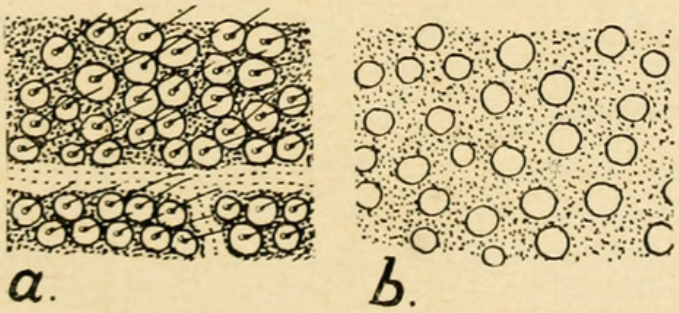
Genotype, *Chiliocycla scolopoides*, n.sp. (Upper Triassic, Ipswich, Q.)

This genus is evidently allied to *Scytinoptera* Handl., but differs from it not only in the remarkable sculpture of the tegmen, but also in the form of the posterior branch of R, which is longer and straighter, the very definite branching of M, with the formation of a definite median cell, and the stronger forking of Cu.

CHILIOCYCLA SCOLOPOIDES, n.sp. (Text-fig. 2).

Total length of preserved portion of tegmen, 6.4 mm., representing a tegmen of about 8 mm. *Greatest breadth*, 2 mm.

The area of strong tuberculation extends from the base outwards to about the level of the apical end of the clavus, with indications of some tubercles along the veins slightly distad from that level. Examined under a fairly high power, the tubercles are seen to be flat and circular, very closely and regularly arranged, there being three rows of them between the two branches of R, three rows between the posterior branch of R and M, three or four rows between M and Cu_1, and three rows between Cu_1 and the vena dividens (Cu_2) which is mostly obliterated in the fossil. Each tubercle is distinctly raised up above the level of the membrane surrounding it. On most of the tubercles there can be made out, situated at or near the centre of the circle, the impression of a socket of a hair or macrotrichia. Tubercles of this kind are not uncommon on the tegmina of existing Homoptera, as, for example, on many *Membracidae*, and in the Cercopid genus *Philagra*, but they are seldom developed over so large an



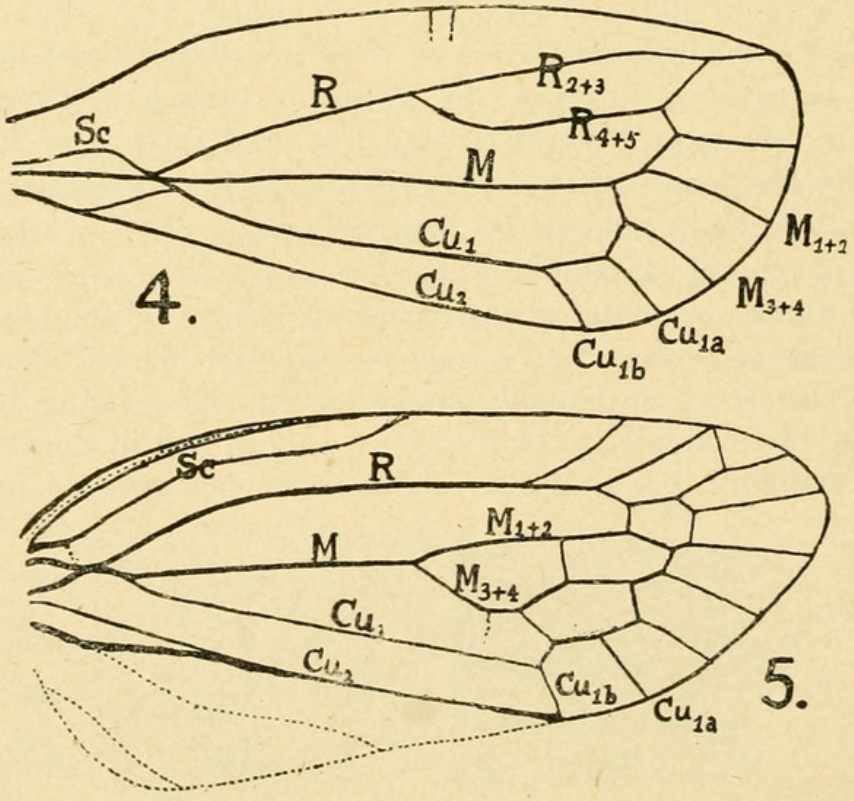
Text-fig.3.

Two small areas from the tegmen of *Philagra* sp. *(Cercopidae)* from Mount Tambourine, Q. *a*, tuberculate area. *b*, normally pitted area. (x 100).

area of the tegmen as in *Chiliocycla*. In Text-fig. 3, I have shown portions of the tegmen of *Philagra* sp., contrasting a tuberculate area (*a*) with a normally pitted area (*b*). In *a*, each tubercle carries a short hair set in a definite socket, alongside of which there is a minute circular area devoid of pigment, probably representing a small gland containing fluid and opening at the base of the hair. I would suggest that the tubercles of *Chiliocycla* only differ from those of *Philagra* in their greater abundance and regularity of arrangement, and in being all of about the same size, those of *Philagra* being unevenly distributed and varying considerably in diameter. No systematic value can be placed upon the presence of these tubercles as regards the family relationships of *Chiliocycla*, as they appear to crop up almost anywhere within the Hemiptera.

Type, Specimen No. 158*a*. (Coll. Queensland Geol. Survey).

Horizon: Upper Triassic, Ipswich, Q.



Text-fig.4. *Scytinoptera kokeni* Handl. From Handlirsch. (x 8). For lettering see p.895.

Text-fig.5. *Mesoscytina australis*, n.g. et sp. (x 7·5). For lettering see p.895. The missing clavus is shown dotted in.

Genus SCYTINOPTERA Handl. (Text-fig. 4).

In Text-fig. 4, I have shown the venation of *Scytinoptera kokeni* Handl., from the Upper Permian of the Kama River, Russia, for comparison with *Chiliocycla, Mesoscytina* and other Ipswich genera defined in this paper. Points to be noted are the peculiar shape of the costal margin, the manner of branching of R, the absence of any definite branch of M, and the very regular arrangement of the veins ending on the distal border of the tegmen. The tegmen is tough and leathery in appearance, and is finely pitted all over.

The genus is monotypic, the genotype having been originally described by Handlirsch in 1904 (Mem. Acad. Petersburg, xvi., (5), 3, 1904, Pl., figs. 3, 4.). See also Handlirsch (3, p. 392).

Genus MESOSCYTINA, n.g. (Text-figs. 5-6).

Closely related to *Scytinoptera* Handl., from which it differs in the following points:—M branches into two at about the middle of the wing; M_{3+4} again divides into M_3 and M_4 distally; the branches of M are connected by cross-veins, so that two closed cells are formed between them. R remains unbranched until well beyond half-way along the wing, when it gives off an ascending branchlet (R_1), and soon after divides into R_{2+3} and R_{4+5} the latter again dividing into R_4 and R_5. Two cross-veins between R_{4+5} and M_{1+2} and two between M_{3+4} and Cu_{1a}; the latter diverging strongly from Cu_2 at its origin. The basal portion of the costal margin is convex, instead of being slightly concave as in *Scytinoptera,* and there is a short vein close below it, which is probably Sc.

Genotype, *Mesoscytina australis,* n.sp. (Upper Triassic, Ipswich, Q.).

Two species are represented in the collection; they may be distinguished as follows:—

Sc faintly indicated, curved, reaching well beyond the curved basal portion of R. ——————————*M. australis*, n. sp.

Sc strongly marked, straight, only reaching about as far as the curved portion of R. ——————————*M. affinis*,n. sp.

MESOSCYTINA AUSTRALIS, n.sp. (Text-fig. 5).

Total length, 9.4 mm.; *breadth* at apical end of clavus, 3.5 mm. Tegmen complete, except for the absence of the clavus,

which has been restored on typical Scytinopterid lines in Text-fig. 5.

Peculiarities in the venation which are probably only of specific value are the following:—the slight double-curving of Sc; the presence of a cross-vein connecting R_4 with the extreme tip of R_{2+3} above it; and the irregular course of M_{3+4} from its origin to the point at which it forks, with the consequent obliquity of the cross-veins connecting both it and M_4 with Cu_{1a}.

Tegmen evidently of a tough, leathery nature, finely pitted all over; the costal margin strongly formed basally.

Type, Specimen No. 112*a*. (Coll. Queensland Geol. Survey).

Horizon: Upper Triassic, Ipswich, Q.

A comparison of this fossil with *Scytinoptera kokeni* Handl. reveals a close similarity in the apical portions; but the four closed cells present in *M. australis,* n.sp. are only represented by a single closed cell, between M and Cu, in *S. kokeni.*

MESOSCYTINA AFFINIS, n.sp. (Text-fig. 6).

Total length of fragment, 6 mm., representing a tegmen of total length about 9 mm. *Greatest breadth,* 3.3 mm.

Tegmen evidently of a tough, leathery nature, strongly pitted all over; all the veins very strongly marked.

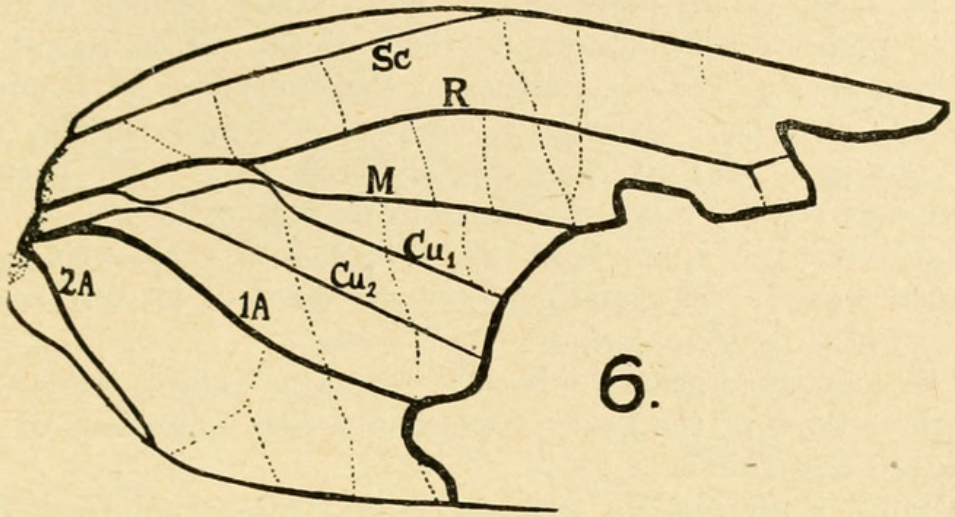
Peculiarities in the venation which are probably only of specific value are the following:—the straight, short course of Sc, and its strongly marked nature; the peculiar curvature of the vein Cu near the base; and the excessive shortness of 2A on the clavus. The dotted lines in Text-fig. 6 indicate definite creases which are probably cracks due to pressure on this tough tegmen during fossilisation.

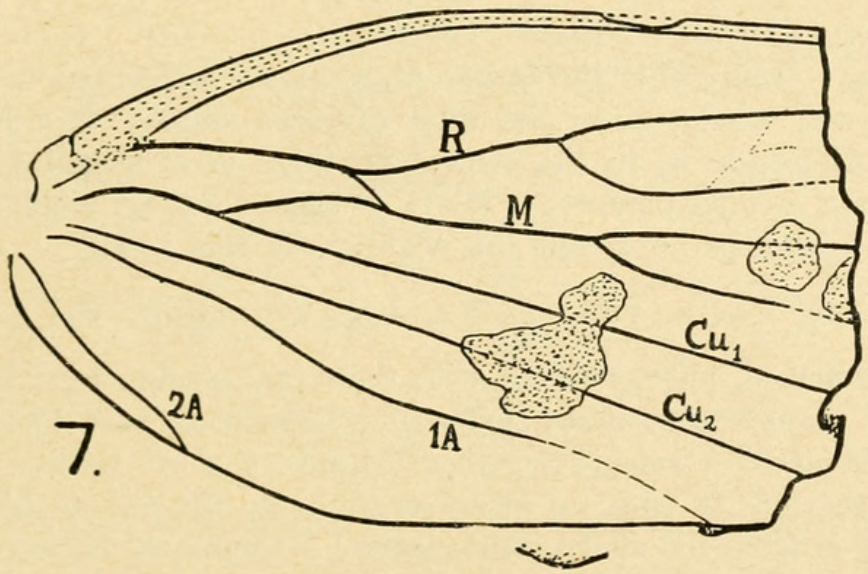
The specimen is very incomplete, being broken off along a very irregular line, as shown in Text-fig. 6. Most of the clavus is preserved, and the vein 1A shows a very definite waviness, 2A being almost straight. The vena dividens, Cu_2, is not very strongly impressed, and there is no difference between the form and size of the pits upon the clavus and the rest of the tegmen.

Type, Specimen No. 235. (Coll. Queensland Geol. Survey)

Horizon: Upper Triassic, Ipswich, Q.

The preservation of the clavus in this fossil is of great value, since it enables us to determine at once what was the form and venation of this area in the more typical *Scytinopteridae.*





Text-fig.6. *Mesoscytina affinis*, n.g. et sp. (x 13·5). For lettering see p.895.

Text-fig.7. *Mesodiphthera grandis*, n.g. et sp. (x 6·3). For lettering see p.895.

Genus MESODIPHTHERA, n.g. (Text-fig. 7).

Differs from *Mesoscytina*, n.g. in having R branching dichotomously at a level just before the branching of M. (Basal half of tegmen only preserved).

Genotype, *Mesodiphthera grandis*, n.sp. (Upper Triassic, Ipswich, Q.).

MESODIPHTHERA GRANDIS, n.sp. (Text-fig. 7).

Total length of fragment, 12 mm., representing a tegmen of total length over 20 mm. *Greatest breadth*, 7.5 mm.

The whole of the basal half or more of the tegmen is excellently preserved, including the whole of the clavus except the extreme apex. The peculiarities of the branchings of R and M are well shown in Text-fig. 7. As far as preserved, Cu_1 is a very straight vein, diverging slightly from Cu_2. The peculiar waviness of 1A is very evident; and this vein, as in *Mesoscytina,* stands very far apart from 2A, which is a short vein, very slightly waved. The anal angle of the clavus is broadly rounded, much as in *Mesoscytina.*

The tegmen appears to be of a leathery nature, but not so tough as those of the genus *Mesoscytina;* the indications of pitting are also fainter.

Type, Specimen No. 213 *a-b.* (Coll. Queensland Geol. Survey).

Horizon: Upper Triassic, Ipswich, Q.

Text-fig. 7 represents the larger piece of the preserved fossil, which is the *mould,* since the vena dividens stands on a high ridge. Alongside it, in the same box, there is a broken piece of the cast, not so perfect; a study of this does not yield any additional information about the venation of this fossil.

Genus Triassoscarta, n.g. (Text-fig. 8).

R unbranched, but connected with the costal margin by a long series of transverse veinlets, extending from near base to near apex. M and Cu arising together by a very short stalk. On the clavus, vein 2A ends up about as far from the end of 1A as the latter is from the apex of the clavus. (Course of M, beyond half-way, obliterated).

Genotype, *Triassoscarta subcostalis,* n.sp. (Upper Triassic, Ipswich, Q.)

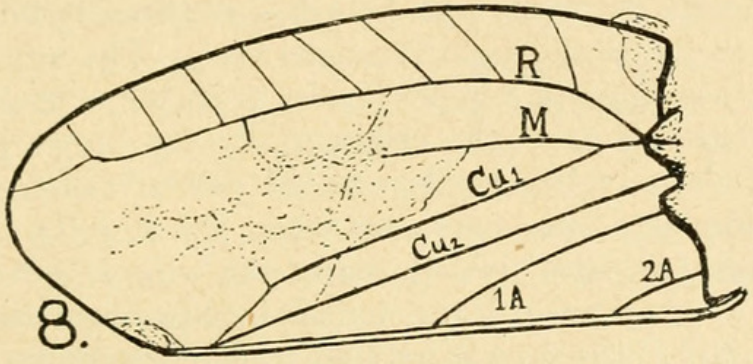
Clearly allied to *Permoscarta,* from the Upper Permian of Newcastle, N.S.W., but differing from it in the simpler structure of R, as explained in the key to the genera.

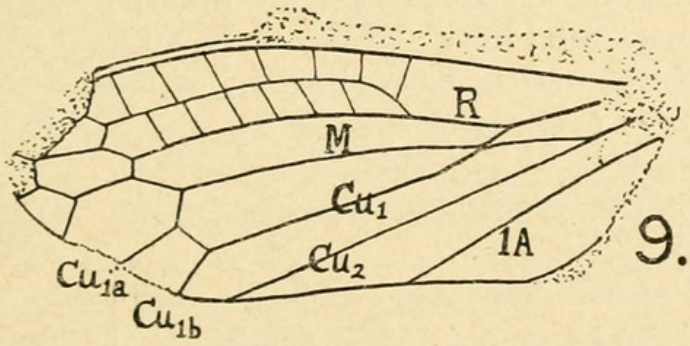
Triassoscarta subcostalis, n.sp. (Text-fig. 8).

Total length, 8 mm. *Greatest breadth,* 3.8 mm.

The number of veinlets connecting R with the costal margin is eight, arranged at approximately equal intervals; the second, third and fourth of these are more obliquely placed than the others. The middle distal portion of the tegmen has the venation obliterated; but there are slight indications that M was

forked near half-way, and the short basal piece of Cu_{1a} visible above the secondary cubital fork suggests that the venation of this part of the tegmen may have resembled somewhat that of *Mesoscytina*. Cu_{1b} is a short, straight vein which descends to meet the vena dividens at the apex of the clavus. 1A and 2A are both well marked, curved veins. The anal angle is well rounded.





Text-fig.8. *Triassoscarta subcostalis*, n.g et sp. (x 7·5). For lettering see p.895.

Text-fig.9. *Permoscarta mitchelli* Till. (x 8·3). For lettering see p.895.

The tegmen appears to be of a leathery nature, finely and closely pitted all over.

Type, Specimen No. 116*a*. (Coll. Queensland Geol. Survey).
Horizon: Upper Triassic, Ipswich, Q.

Genus PERMOSCARTA Till.

We figure the tegmen of *Permoscarta mitchelli* Till. in Text-fig. 9, for comparison with that of *Triassoscarta subcostalis*, n.sp. The genus comes from the Upper Permian of Newcastle, N.S.W. (9, p. 726). The chief differences between the two types are given in the generic key above. We may note, in addition, that the radius of *Triassoscarta* arches strongly upwards near the

base, much as the upper branch of R does, further on, in *Permoscarta;* that, in this latter genus, Cu_{1a} does not end at the apical angle of the clavus; and that vein 2A seems to be absent.

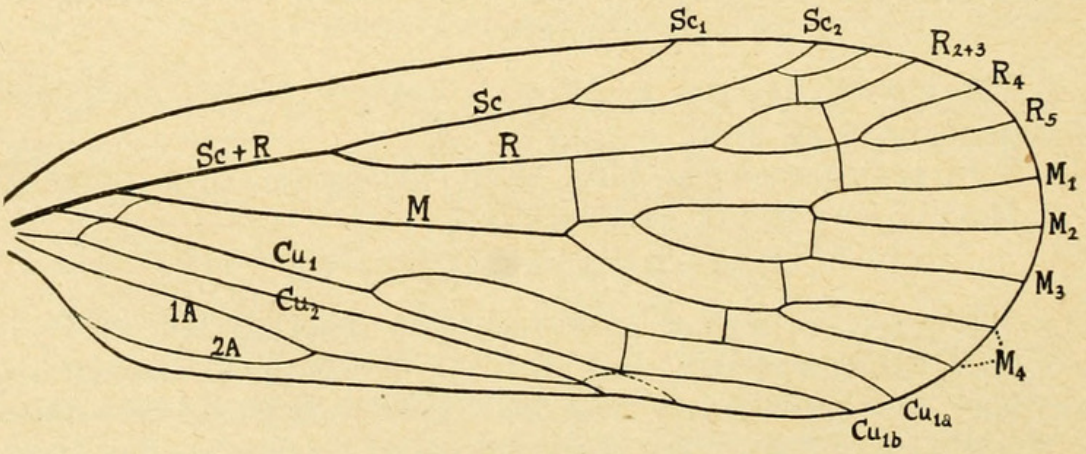
Subfamily MESOCIXIINAE.

Genus MESOCIXIUS, n.g. (Text-fig. 11).

Tegmen considerably broader near base than towards apex. Costal area fairly wide. R branches dichotomously at about one-third of the wing length from the base. The upper branch of R branches again at a point further from the original forking than the latter is from the origin of R; the upper branch so formed sends only two veinlets to the costal border, while the lower divides into two simple branches, R_2 and R_3. M forks dichotomously at about two thirds of the wing length from the base; the upper branch, M_{1+2} divides into two near the border; the lower, M_{3+4}, has four short, subparallel, descending branches. A closed median cell is present, by a strong cross-vein. Cu_1 has a strong distal fork. Cu_{1b} ends up a little beyond the apical angle of the clavus, while Cu_{1a} is itself forked near the wing border. Cross-veins connect R_1 with R_2, R_{4+5} with M_{1+2} and M with Cu_{1a}. (Clavus not preserved).

Genotype, *Mesocixius triassicus,* n.sp. (Upper Triassic, Ipswich, Q.).

It is, of course, impossible to decide whether Sc is really present in this fossil or not. The naming of the branches of R is given only provisionally, to facilitate comparison with other genera of the family. If this genus and the succeeding one



Text-fig. 10.

Nesocharis sp., tegmen (*Cixiidae*). (x 12). For lettering see p.895.

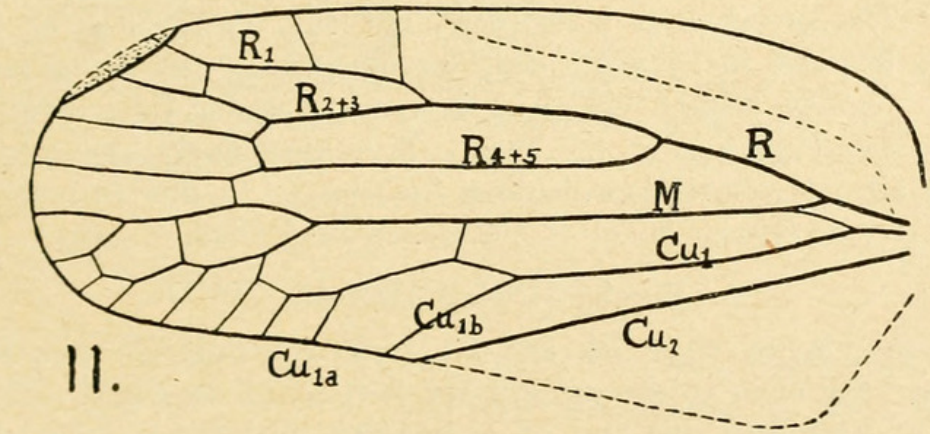
really belong to a group ancestral to the true *Cixiidae,* then it should be noted that the first dichotomy of the vein here called R is really a dichotomy of a fused stem R-Sc into Sc above and R below, and that Sc branches again, while R remains unbranched. For comparison of the venations of the fossil with the true *Cixiidae,* I give, in Text-fig. 10 the venation of the tegmen of *Nesocharis* sp.

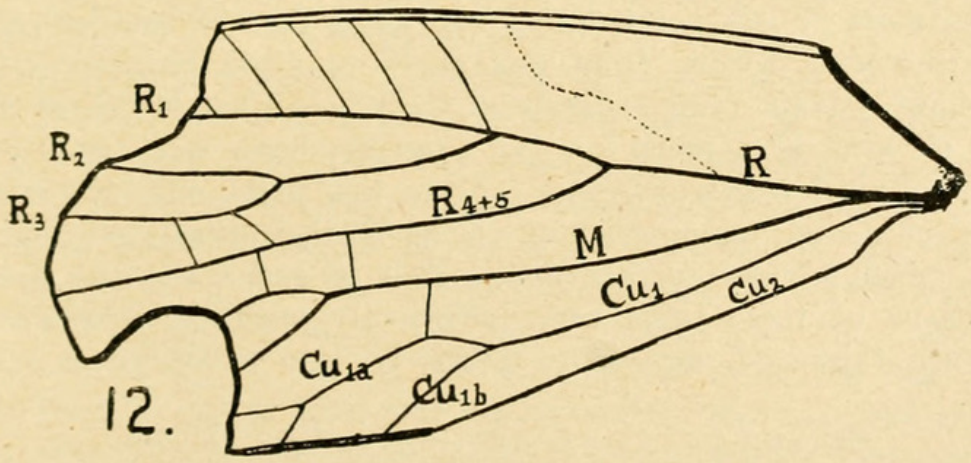
MESOCIXIUS TRIASSICUS, n.sp. (Text-fig. 11).

Total length of tegmen, 10 mm. *Greatest breadth,* 4 mm.

The venational characters have been included in the generic definition. The tegmen appears to have been moderately tough and leathery, and is finely and closely pitted all over. The specimen is complete, except only for a tiny piece missing above the apex, and the loss of the clavus, which, as usual, has become detached along the groove of the vena dividens.

Type, Specimen No. 215 (Coll. Queensland Geol. Survey).





Text-fig.11. *Mesocixius triassicus*, n.g. et sp. (x 7·5). For lettering see p.895.

Text-fig.12. *Triassocixius australicus*, n.g. et sp. (x 7·5). For lettering see p.895.

Genus TRIASSOCIXIUS, n.g. (Text-fig. 12).

Allied to *Mesocixius*, from which it differs by the closer approximation of the first and second dichotomies of R, and by the presence of a series of oblique veinlets running from the most anterior branch of R to the costal border. The condition of the media and cubitus is much the same as in *Mesocixius*, but there are two cross-veins between R_{4+5} and M, and also between R_3 and R_{4+5}. (Clavus not preserved.)

Genotype, *Triassocixius australicus*, n.sp. (Upper Triassic, Ipswich, Q.).

With regard to the naming of the branches of R, the same remarks apply to this genus as to the previous one.

TRIASSOCIXIUS AUSTRALICUS, n.sp. (Text-fig. 12).

Greatest length of fragment, 10.5 mm., representing a tegmen of total length about 12.5 mm. *Greatest breadth*, 5 mm.

The venational characters are included in the generic definition. The specimen is incomplete, not only in the loss of the clavus, but also in having a considerable part of the apical area of the tegmen broken off along a very irregular line, together with a small portion of the base. It is very finely and closely pitted all over, closely resembling *Protocixius* in this respect.

Type, Specimen 267*a*. (Coll. Queensland Geol. Survey).

Family IPSVICIIDAE.

On the clavus, veins 1A and 2A form a definite Y-vein, but 2A lies very close to the margin for portion of its length. Tegmina of moderate size and of a peculiar cultriform shape, the apex more or less pointed, the anal angle strongly marked, and the posterior border from this angle to near the apex quite straight. Main veins separate at their bases, but Sc, R, M and Cu all meet at a point not far from the base, much as in the more typical *Scytinopteridae*. From this point only two veins proceed distad, the anterior one being R, the posterior one M + Cu, which divides further distad into M and Cu. The distal portions of these veins very indistinctly marked. Border of tegmen thickened, especially anteriorly, into a coriaceous margin.

Genus IPSVICIA, n.g. (Text-figs. 13-15).

R gives off a series of transverse branches to the anterior border. Cu diverges from M at about one-third of the wing-

length from the base, or less. The whole tegmen is covered with irregularly placed patches of small tubercles, very definitely preserved in the fossils, and apparently originally pigmented; these give a very definite pattern to the tegmen, and are of quite a unique appearance. Between these patches, the tegmen is finely pitted all over, the pits being shallow and placed farther apart than are the tubercles in the patches, and evenly aligned along the courses of the main veins.

Genotype, *Ipsvicia jonesi*, n.sp. (Upper Triassic, Ipswich, Q.).

Three species of *Ipsvicia* are represented in the Ipswich Beds. They may be separated by the following key:—

(1) Apex of tegmen sharply pointed. ——— *I. acutipennis*, n. sp.
(1) Apex of tegmen broader and more rounded. ——— 2.

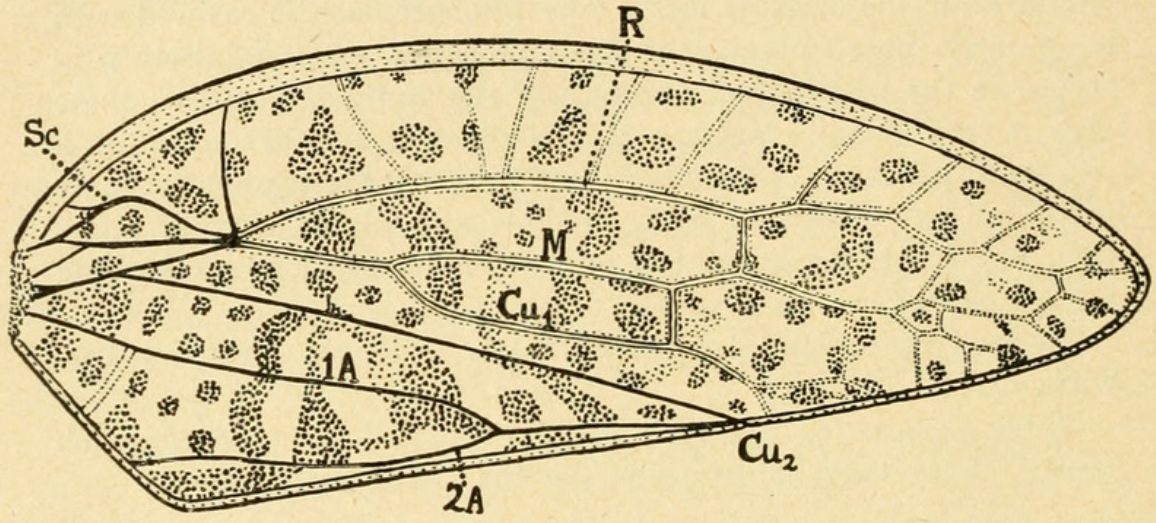
(2) M and Cu united for a distance distinctly less than the width of the space between R and the costal border above it. Tubercular patches distinct and well separated. ——— *I. maculata*, n. sp.
(2) M and Cu united for a distance slightly greater than the width of the space between R and the costal border above it. Tubercular patches larger, some of them more or less confluent. ——— *I. jonesi*, n. sp.

Ipsvicia jonesi, n.sp. (Text-fig. 13).

A complete and beautifully preserved tegmen, representing the *mould* of a left tegmen, and therefore having its apex to the right (1A stands on a high ridge in the fossil, whereas in the actual wing it lies in a deep furrow).

Total length, 14.2 mm. *Greatest breadth*, 5.6 mm.

Veins of the clavus distinct, those of the rest of the tegmen faint, becoming very indistinct distally, so that their terminal branchlets cannot be made out with certainty. (This is not due to faulty preservation, but is the actual condition of the venation in the insect, as in the case of *Philagra* and other Fulgoroids, in which the membrane of the tegmen has become much thickened). Sc, R, M and Cu are well-marked from the base to their point of union, from which a transverse vein runs upwards, very distinctly, to the costal border. Costal border coriaceous, wide and strongly built. Between it and R there are altogether nine weakly-indicated cross-branches, besides the one already



Text-fig. 13.

Ipsvicia jonesi, n.g. et sp. (x 6·7). For lettering see p.895.

mentioned. Of these, the first is inclined upwards and inwards obliquely, the second is very faint and also slightly inclined upwards and inwards, the third arises on R very close to the second, but inclines upwards and outwards, the rest are placed at fairly equal intervals, inclined upwards and outwards, the ninth being a small twig near the end of R. R is united with M, at about one-third of the wing-length from the base, by a strong cross-vein, and, beyond this, by two more very indistinct and somewhat oblique cross-veins, which thus separate out, between R and M, two distinct, irregular polygonal areas. Below these, M branches into weak and irregular twigs, very difficult to follow. M is connected with Cu by a well-marked cross-vein at a level somewhat basad from the strong cross-vein connecting R with M. Beyond this, Cu becomes very faint, but appears to arch downwards so as to end up close to the apex of the clavus, and gives off also a faint distal branch, which is connected again with M by a faint cross-vein. In the clavus, the Y-vein is very distinct, but 3A must be followed out with care, as it runs very close to the border, and might be mistaken for it under a cursory survey.

The pattern of the tubercular patches is well shown in Text-fig. 13. The smaller patches are round or oval, the larger ones often reniform, and some of them are connected by areas in which tuberculation is evident, but not so strongly developed. The preservation of the separate, minute, flattened tubercles forming these patches is perfect.

This tegmen appears almost unicolorous in the fossil; but it is probable that the tubercular areas would have appeared pigmented in the cast, if that had been preserved, seeing that, in the other two species, in which portions of both cast and mould are preserved, the former shows the patches strongly darkened.

Type, Specimen No. 122*a*. (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.

This tegmen is certainly the most perfect of all the Ipswich fossils, and it would be hard to imagine that any wing could be preserved in better condition.

It gives me much pleasure to dedicate this species to Mr. A. J. Jones, the present Minister for Mines in Queensland.

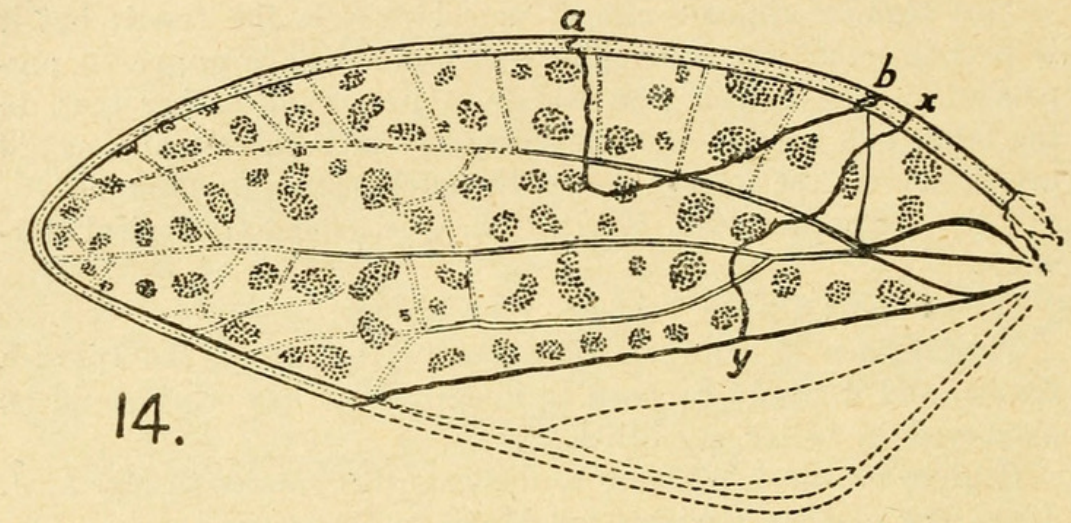
IPSVICIA MACULATA, n.sp. (Text-fig. 14).

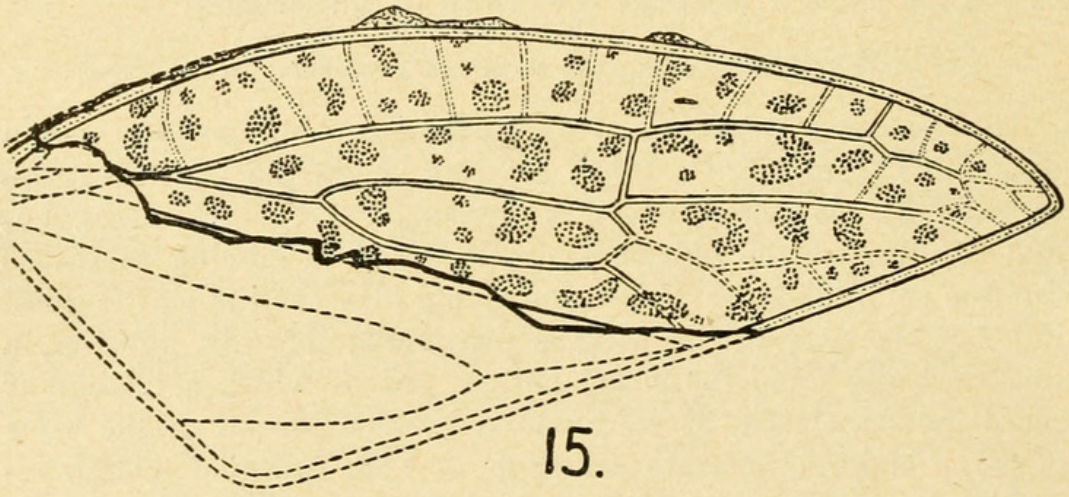
This species is represented by portions of both cast and mould of a right tegmen. Of these, the cast shows the whole tegmen, except only the clavus, which is broken off irregularly along 1A, and the base of the tegmen above it, which is missing as far as the line *xy* in Text-fig. 14. The mould also has the clavus missing, but the base of the wing is preserved; there is, however, a piece missing from the costal border, out of which a triangular piece has been torn, as represented by the line *ab* in the same figure. Making separate drawings of both cast and mould, reversing one and placing it on top of the other, we get the composite figure shown in Text-fig. 14, which has been drawn with apex to the left, for convenience of arrangement with the figures of the other two species.

Total length, 13.5 mm. *Greatest breadth,* 4.6 mm. at apex of clavus, representing a probable maximum breadth at the claval angle of about 5.8 mm.

This species comes close to *I. jonesi,* n.sp., from which it may be distinguished as follows:—

The coriaceous costal border is not so strongly built. The width across the tegmen at the apex of the clavus is greater, though the total length of the tegmen is slightly less; this indicates a somewhat different shape, as shown in the restored tegmen in Text-fig. 14. Veins very faintly indicated. R tends to converge towards the costal border distally, so that the space between them narrows gradually, instead of remaining nearly the same length throughout, as in *I. jonesi.* There are ten cross-





Text-fig.14. *Ipsvicia maculata*, n.g. et sp. (x 6·7). The missing clavus is shown dotted in, restored on the plan of *I. jonesi*. For lettering see p.895.

Text-fig.15. *Ipsvicia acutipennis*, n.g. et sp. (x 6·7). The missing clavus is shown dotted in, restored on the plan of *I. jonesi*. For lettering see p.895.

veins in this space, including the one from the point of union of the main veins; these are more regularly spaced than in *I. jonesi,* the second and third being at a normal distance apart. Instead of R and M being united by a straight cross-vein, at a distance of one-third the wing-length from the apex, as in *I. jonesi,* R appears to give off a weak posterior branch somewhat beyond half-way along the wing, and the cross-vein to M descends from this branch, whose further course is obliterated.

M and Cu are united for a much shorter length than in *I. jonesi;* their distal courses are too faint to be made out with certainty. The tubercular patches are smaller, more distinct and more separated than in *I. jonesi,* and appear of a dark brown colour on a pale ground. Between these patches, the tegmen is strongly pitted all over, the pits being fairly large and shallow, and placed considerably further apart than are the tubercles of the patches. The courses of the veins are marked by the regular arrangement of these pits along either side of them.

Type, Specimens 208*a* (cast) and 208*b* (mould), in separate boxes. (Coll. Queensland Geological Survey).

Horizon: Upper Triassic, Ipswich, Q.

The specific name indicates the very strongly spotted appearance of the tegmen, especially in the cast, when viewed with the naked eye.

IPSVICIA ACUTIPENNIS, n.sp. (Text-fig. 15).

This species is represented by a well preserved cast, broken off irregularly along the vein 1A, so that the whole of the clavus and a small portion of the base are missing; also by a small portion of the mould, showing only the middle parts of the veins R, M and Cu.

Total length, 13.5 mm. *Greatest breadth,* 4 mm., just beyond apex of clavus.

Apex much more acute than in the two preceding species, the costal coriaceous border less strongly marked, the space between costal margin and R distinctly narrower, and crossed by twelve regularly arranged cross-veins. R is united with M by a strong cross-vein as in *I. jonesi,* but the course of M beyond this point is much straighter than in that species. M united with Cu for about the same distance as in *I. jonesi;* just before the level of the cross-vein connecting it with R, M gives off a descending branch, which meets the upper branch of Cu, thus forming an elongate closed area between them. Distal courses of Cu and lower branch of M indistinct, but rest of venation more clearly marked than in the other two species.

Tubercular patches small, distinct and separate, much as in *I. maculata,* the previous species, and appearing strongly pigmented in dark brown, on a pale ground-colour, especially in the cast.

Type, Specimens 204*a* (cast) and 204*b* (mould), glued side by side in a single box. (Coll. Queensland Geological Survey).
Horizon: Upper Triassic, Ipswich, Q.

Family JASSIDAE.

Sc usually absent; if present, weakly formed, and not looped up with R as in *Cercopidae*. R, M and usually Cu_1 fused together into a single stalk basally for an appreciable distance. Clavus triangular, the anal angle obtuse; separated from the rest of the tegmen by a straight vena dividens (Cu_2). No claval Y-vein; the claval veins 1A and 2A both usually present, placed far apart. 1A usually waved, 2A enclosing the anal angle.

Key to the Upper Triassic Genera.

(1)
- Cu_{1b} ending up exactly at apex of clavus; apical third of tegmen with many closed cells. ——— *Eurymelidium*, n.g.
- Cu_{1b} ending up somewhat beyond apex of clavus; apical third of tegmen with few closed cells. ——— 2.

(2)
- R without apparent longitudinal branches; the median cell *(mc)* normal, without any supporting cells beneath it. ——— *Mesojassus* Till.
- R with definite longitudinal branches; the median cell *(mc)* abnormal, divided by a cross-vein, and with small supporting cells between it and the cubitus. ——— *Triassojassus*, n.g.

Genus EURYMELIDIUM, n.g. (Text-fig. 16).

Sc absent. R, M and Cu_1 fused together for a considerable distance from base. Distance between origin of Cu_1 from common stem and point of separation of R from M less than length of common stem of all three veins. After leaving M, R arches up considerably towards costa, then bends away again, dividing into R_{2+3} and R_{4+5}, the latter fusing almost at once with M_{1+2}. Between R_{2+3} and costal margin is a series of transverse veinlets, of which the first may represent the shortened R_1. Courses of R_{2+3} and R_{4+5} somewhat irregular, the space between them divided by three cross-veins into cells. After leaving R, M bends downwards; about the middle of the wing, it divides into M_{1+2} and M_{3+4}, the former arching up to unite with R_{4+5}, the latter continuing straight on; the space between the two branches of M is divided up by four cross-veins into cells. Two cross-veins connect M with Cu, one being not far from the origin of M

from the common stalk, the other much further distad. Cu_{1a} fused with M_{3+4} for a short distance, so that its basal portion resembles a cross-vein. Cu_{1b} ending up exactly upon the apical angle of the clavus. On the clavus, 1A is waved and diverging strongly from the vena dividens.

Genotype, *Eurymelidium australe*, n.sp. (Upper Triassic, Ipswich, Q.)

EURYMELIDIUM AUSTRALE, n.sp. (Text-fig. 16).

Total length of preserved portion of tegmen, 5 mm., representing a complete tegmen of about 5.5 mm. long. *Greatest breadth*, 2 mm.

The tegmen is closely pitted all over, the venation being fairly strongly marked. There is a slight piece out of the costal margin near the middle, and a small part of the base is missing; otherwise, the preservation is complete. The venational characters have been included in the generic definition.

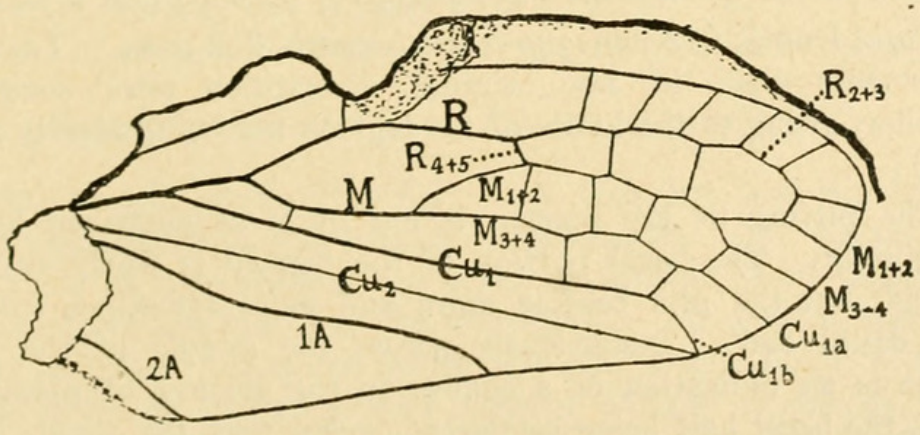
Type, Specimen No. 248*a*. (Coll. Queensland Geol. Survey).

A comparison with Text-fig. 1*c* will show the resemblance of this fossil to the existing Australian genus *Eurymela*.

Genus MESOJASSUS Till. (Text-fig. 17).

Mesojassus Tillyard, 1916 (8, p. 34).

Sc slightly indicated as a separate vein running a little below the costal margin. R, M and Cu_1 united in a common stalk for a considerable distance from base, Cu_1 coming off from it very strongly, M as a weakly indicated vein at a considerably further distance along it. R with no longitudinal branchings, but giving



Text-fig. 16.

Eurymelidium australe, n.g. et sp. (x 13·3). For lettering see p. 895

off a strong transverse veinlet (probably R_1) before half-way, then running straight and without any branches for some distance, and finally becoming slightly zig-zagged distally, giving off two more veinlets to the costal margin, and connected with M_{1+2} by two cross-veins. Main stem of M very weakly chitinised; it divides into two about the middle of the wing, and remains weak for the basal half of the length of the median cell (*mc*) after which it becomes more strongly marked. Median cell (*mc*) of normal form, closed distally by a cross-vein, and connected below by another cross-vein with Cu_{1a}. Distal fork of Cu_1 very small; Cu_{1b} ending up at an appreciable distance from the end of the vena dividens. On the clavus, 1A is waved, but diverges very little from Cu_2; 2A encloses the anal angle.

Genotype, *Mesojassus ipsviciensis* Till. (Upper Triassic of Ipswich, Q.)

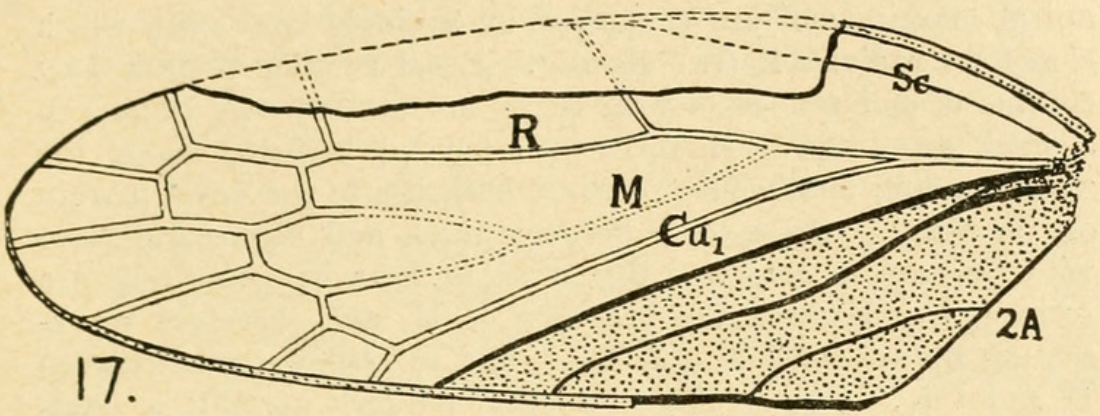
My original definition of this genus (8, p. 34) was very incomplete, as I had not then succeeded in obtaining a really good drawing of the fossil, in which the impression of the venation is weak, especially in the region of M. The drawing given in Text-fig. 17 was made under exceptionally good conditions in very strong, oblique, evening sunlight, and adds much to our knowledge of this interesting fossil form. In the original generic definition, the condition of the pitting of the wing was included. I do not now regard this as of more than specific value. The genus itself is not far removed from the recent genus *Jassus*.

MESOJASSUS IPSVICIENSIS Till. (Text-fig. 17).

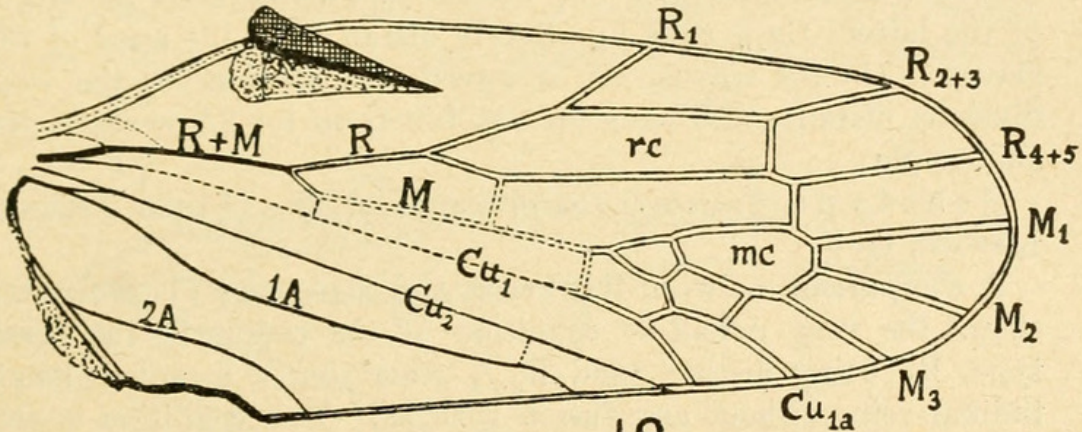
Mesojassus ipsviciensis Till., 1916, (8, p. 35, Plate 2, fig. 7).

Total length, 6.2 mm.; *greatest breadth,* 2.2 mm. (The measurements given in my original description were somewhat smaller, owing to the limits of the tegmen not being clearly made out).

The pitting of the tegmen is not quite as described by me originally. The basal portion of the tegmen is fairly strongly pitted, but the pits become more and more indistinct towards the distal end. Transversely across the middle of the wing there is an indication of a change in the amount of pigmentation, the basal half being somewhat darker than the distal; but I do not think that this line indicates the limit of any special development of the pitting.



17.



18.

Text.fig.17. *Mesojassus ipsviciensis*, Till. (x 15). For lettering see p.895.

Text-fig.18. *Triassojassus proavitus*, n.g. et sp. (x 15). For lettering see p.895.

Apart from the fact that there is a considerable portion of the costal area missing, this tegmen is perfect.

Type, Specimen No. 33. (Coll. Queensland Geol. Survey).

Genus TRIASSOJASSUS, n.g. (Text-fig. 18).

Costal margin strongly arched from near the base outwards in the basal third of the tegmen. Sc absent. Cu_1 departing from R + M very close to the base. R and M fused together for more than one-fourth of the wing-length. R divides, a little before half-way along the wing, into R_{1-3} and R_{4+5}. The former gives off R_1 as a very distinct oblique veinlet to the costal margin, a little beyond half-way along the wing. R_{2+3} and R_{4+5} run subparallel to one another and unbranched to the

apical margin, and are connected by a single cross-vein, which closes the radial cell (*rc*) distally. Basal portion of M weakly chitinised, and connected with R_{4+5}, not far from its origin, by a weak cross-vein. M forks well beyond half-way along the wing, sending finally three distinct branches to the distal margin of the wing. Cross-veins between these and connecting them with Cu_1 are so arranged that a set of four irregular cells are formed, two between the branches of M, and therefore representing the true median cell (*mc*), and two below these, between M and Cu_1. Cu_1 weakly chitinised, its fork normal; a short, weak cross-vein connected Cu_1 with M just distad from the origin of the latter; Cu_{1b} ends up slightly distad from the apex of the clavus. On the clavus, 1A is waved, but approaches the vena dividens distally, and ends up not far from it; 2A encloses the anal angle.

Genotype, *Triassojassus proavitus*, n.sp (Upper Triassic, Ipswich, Q.).

A comparison between this genus and *Eurymela* (Text-fig. 1*c*) shows the very primitive condition of the radius in the fossil type, R_1 being distinct, and R_{4+5} remaining a complete longitudinal vein, without any fusion with M. This condition is also to be found in the Liassic genus *Archijassus* Handl. (3, p. 501), which also agrees with *Triassojassus* in having the median cell divided by a cross-vein. *Archijassus*, however, has two cross-veins connecting R_{2+3} with R_{4+5}, and three connecting the latter with M_{1+2}; also, it has four distinct distal branches to M, and, apparently, from Handlirsch's figure (3, Atlas, Plate xliii., fig. 41, copied from Geinitz) it had not less than three distinct anal veins upon the clavus, like the Permian genus *Permofulgor*. Handlirsch figures three other species placed provisionally in *Archijassus*, but they are not well preserved, and need not be discussed here.

TRIASSOJASSUS PROAVITUS, n.sp. (Text-fig. 18).

Total length, 5.8 mm. *Greatest breadth*, 2.2 mm.

The tegmen is beautifully preserved, and complete except for a small piece missing at the anal angle of the clavus, and the mark of the knife or chisel used in delamination of the rock, which has cut into the costal area as shown in Text-fig. 18. The impression is of a dark colour, finely pitted on the clavus, but elsewhere almost smooth. As the vena dividens stands upon a

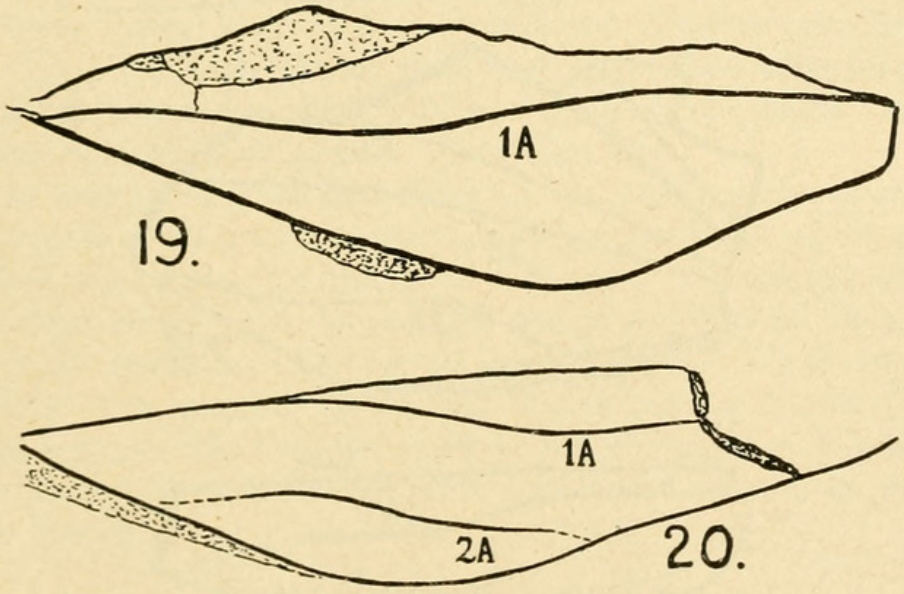
high ridge, the impression is actually a *mould* of a left tegmen, and the pits of the clavus appear as slightly raised tubercles.

Type, Specimen 191*a*. (Coll. Queensland Geol. Survey).

Unnamed Claval Areas.

Amongst the fossil Homoptera dealt with in this paper, there are five portions of tegmina consisting chiefly or entirely of the claval area, which are worth figuring, though they cannot be named. These are Specimens No. 109*a*, 163, 172*a*, 247*a-b* and 257*b*.

Specimen No. 109a is shown in Text-fig. 19. It is portion of the clavus of a very large tegmen, the fragment measuring

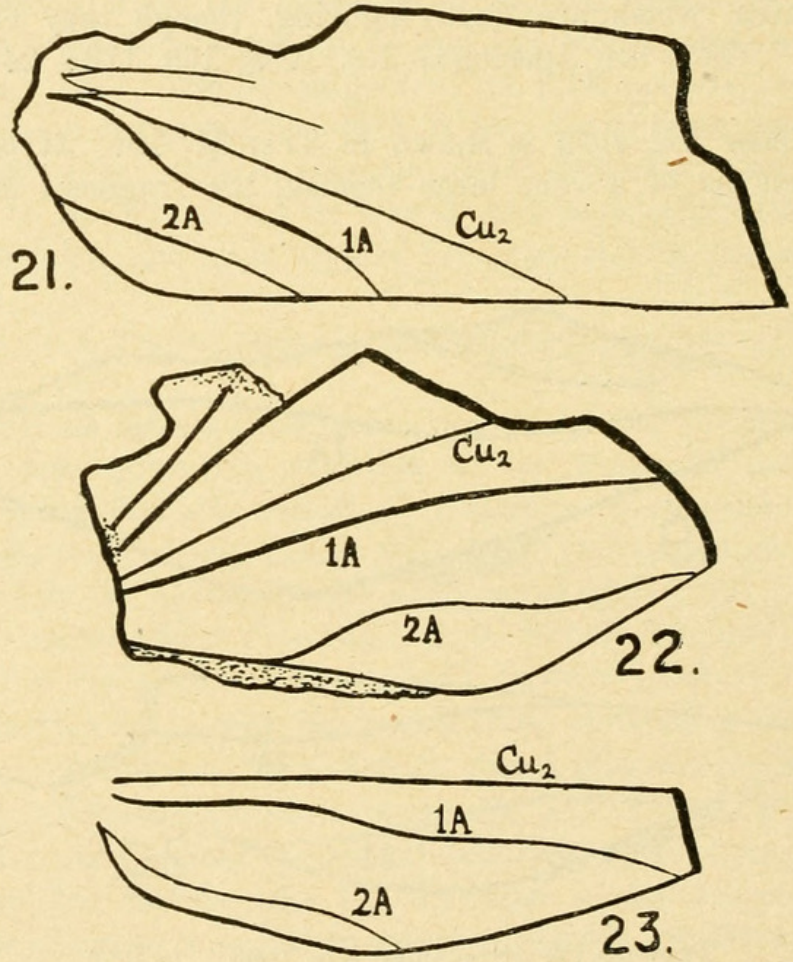


Text-fig.19. Specimen No. 109*a*. (x 6·7).

Text-fig.20. Specimen No. 163. (x 6.7).

10.5 mm. in length, so that the complete clavus must have been at least 12 mm., and the tegmen probably 15 mm. or more in length. The specimen is a mould, showing only the vein 1A strongly impressed upon a tough, leathery clavus with shallow, irregular pitting and considerable pigmentation in the form of large, dark patches of irregular shape. 2A is absent; hence it is possible that it belonged to a large Cercopid.

Specimen No. 163 is shown in Text-fig. 20. This is somewhat more complete than the last specimen, and shows most of 1A, together with all of 2A, on a clavus which is unicolorous and finely pitted all over. The specimen is a *cast*. Total length, 10 mm. It probably belongs to a large Scytinopterid.



Text-fig.21. Specimen No. 172*a*. (x 7·5).
Text-fig.22. Specimen No. 247*a-b*. (x 7·5).
Text-fig.23. Specimen No. 257. (x 7·5).

Specimen No. 172a is shown in Text-fig. 21. A considerable portion of the tegmen is preserved, but there is no definite venation except upon the clavus. Cu_2, 1A and 2A are all clearly marked, together with the extreme basal portions of the veins

Cu_1 and M. The tegmen is roughly granulate. Total length of fragment, 5 mm., of clavus, 3.6 mm. In this specimen, vein 1A is waved, and diverges from Cu_2 much as it does in the genus *Eurymelidium*. But 2A is nearly straight, and ends up rather close to 1A. The specimen may possibly belong to the *Jassidae*.

Specimen No. 247a-b shows, in the same box, side by side, portions of the cast and mould of the base of a fairly large tegmen, of a dark colour and tough, leathery appearance, and lightly granulate all over. Total length of fragment, nearly 7 mm. About half of the vena dividens (Cu_2) is preserved, with most of 1A and the whole of 2A and the anal angle; there are also short pieces of Cu_1 and M shown above these. 1A is fairly straight, 2A very waved, a condition which suggests some resemblance to Scytinopterid genus *Triassoscarta*. (Text-fig. 22).

Specimen No. 257b is a nearly complete clavus, finely pitted, and about 7 mm. long. 1A is waved, and diverges considerably from Cu_2. 2A is waved, and runs very close alongside the somewhat flattened-in anal border. This clavus should belong to some Scytinopterid genus. (Text-fig. 23).

It is worthy of note that none of the claval areas preserved in the Ipswich Homoptera, with the single exception of the genus *Ipsvicia*, shows any formation of a Y-vein. In the *Ipsviciidae*, the Y-vein is only just formed, 2A being, for part of its length, very close indeed to the border of the clavus. But for this character, the venation of the rest of the tegmen in this family would suggest that they belonged to the *Cercopidae*, though the condition of Sc is probably more specialised than it is in this latter family.

Other Unnamed Specimens.

Besides the above, there are no less than five specimens which I have considered too fragmentary or too poorly preserved to merit either naming or figuring. These are Specimens No. 164*a*, 164*b*, (mould and cast, respectively, of the same tegmen), 176*a*, 184*a*, 192*a-b* and 234. Of these, No. 184*a* appears to be a tegmen of the genus *Triassoscarta*, the basal part of the series of costal veinlets being clearly visible. No. 192*a-b* shows two main veins branching much like R and M in *Mesodiphthera*, and is evidently a small part of a large tegmen. The rest are too poorly preserved to invite comment.

NOTE ON THE PHYLOGENY OF THE HOMOPTERA.

A study of the known Homoptera from Permian and Triassic strata should now convince us that the forms which I have included under the family *Scytinopteridae* represent very closely the original type of tegmen for this Suborder. There was little or no fusion of the veins at the base of the wing, and great diversity of the manner of branching of R, M and Cu. The clavus was marked off from the rest of the wing along a fairly straight *vena dividens* (Cu_2), and its anal angle was more or less rounded, not angulated. Either three, or only two, anal (or claval) veins were present, without any approach to union of 1A with 2A to form a Y-vein. This type, as represented by *Scytinoptera* in the Upper Permian, or by the allied *Mesoscytina* or *Chiliocycla* of the Upper Trias of Ipswich, is not very far removed from the Palæohemipterous genus *Prosbole,* from the Upper Permian, from which I have already pointed out that the Triassic *Dunstaniidae,* and therefore the whole of the Heteroptera, may be derived.

As far as we know at present, the only recent family that appears in the Trias is the *Jassidae.* The *Ipsviciidae* are to be regarded as an early specialisation of a remarkable kind, possibly foreshadowing the later *Cercopidae,* but almost certainly not ancestral to these latter. They may be considered as having died out, leaving no recent representatives. True *Cercopidae* appear first in the Lias, there being no reason, so far as I can see, to doubt that Handlirsch's *Procercopis* belonged to this family. True Fulgoroids also appear for the first time in the Lias (genus *Fulgoridium* Handl.). But this great group, which in many respects represents the highest development of the old Auchenorrhynchous stem, may well have originated amongst the Cixiid-like forms of the subfamily *Mesocixiinae* within the family *Scytinopteridae,* by development of the claval Y-vein from the more primitive Scytinopterid condition.

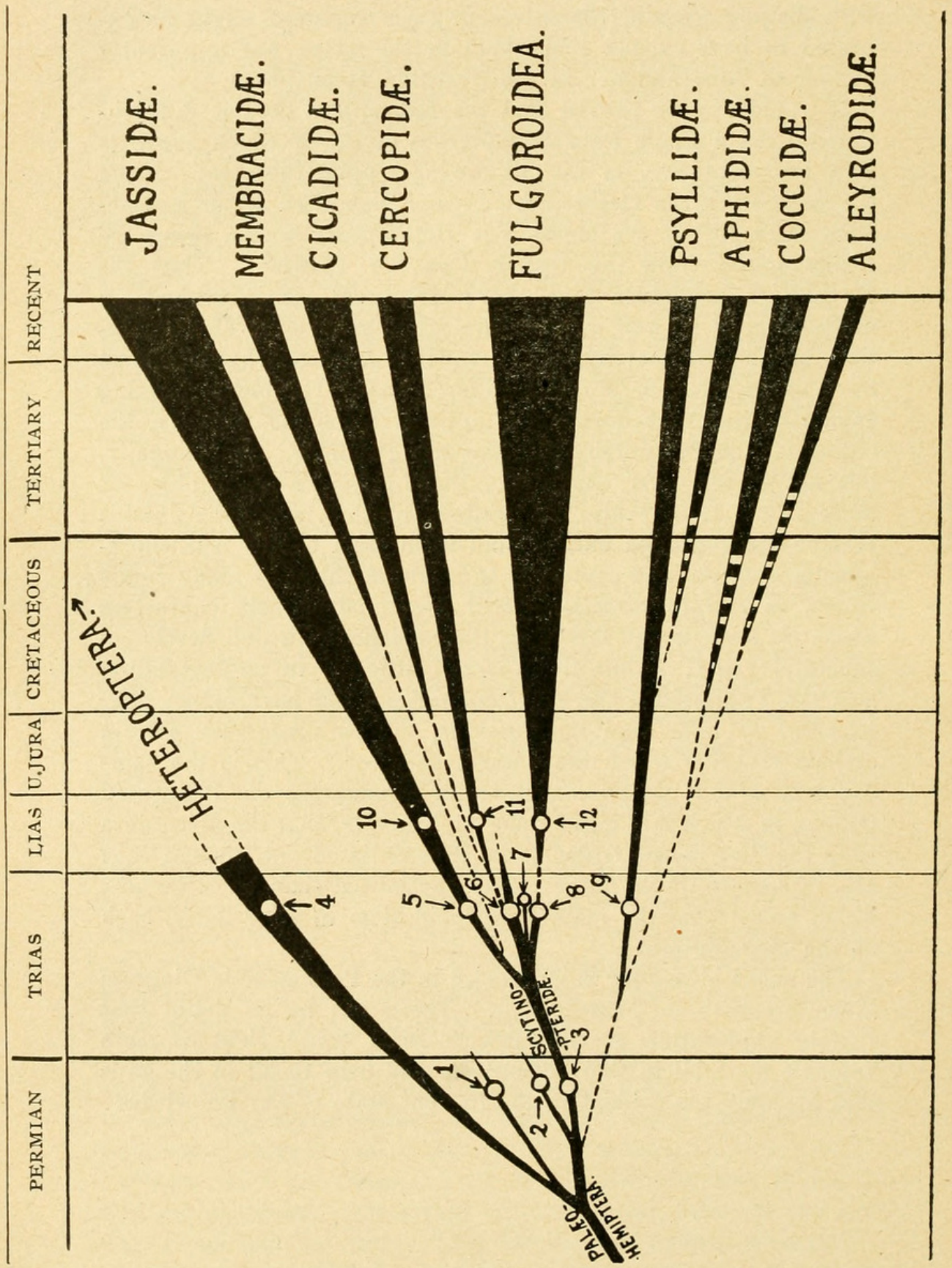
The oldest known Psyllid is *Triassopsylla* from the Upper Trias. This family is also known from the Lias. The *Aphididae, Coccidae* and *Aleyrodidae* are later and more specialised developments from the same stem as the *Psyllidae.*

Structurally the *Cicadidae* are undoubtedly archaic in many of their characters. But they are not found fossil before the Cretaceous, and the origin of the family is at present a mystery. They are undoubtedly closely allied to the *Cercopidae.* Ancestors

with distinct Cicadid characters in their venation might be expected to have existed somewhere in the Trias, but apparently neither in Australia nor in the Northern Hemisphere.

It would appear proved that the Homoptera became differentiated from a single Palæohemipterous stock, of which *Prosbole* is a representative, in the Middle or Upper Permian. From the same stock the Heteroptera became separated off at a somewhat later period, the oldest true Heteroptera known being the *Dunstaniidae* from the Upper Trias of Ipswich. Thus the Homoptera are older than the Heteroptera, as is evident on morphological as well as palæontological grounds. The separation of the Sternorrhyncha from the Auchenorrhyncha must have taken place before the Upper Trias. The oldest existing family of the Auchenorrhyncha appears to be the *Jassidae;* the oldest of the Sternorrhyncha are the *Psyllidae.* Venationally, but not in all other characters, the *Jassidae* are the older of these two. It may also be pointed out that, after the Jassids became differentiated out, the old main stem of the Auchenorrhyncha went on, and continued to be represented by many forms which, *in certain directions,* still preserved archaic characters which the Jassids had lost (e.g., the existence of a well developed subcostal vein). Thus there is no difficulty in understanding how the Fulgoroidea and the *Cercopidae* could have arisen *later in point of time* than the *Jassidae,* though preserving certain archaic features which the Jassids had lost. This is the same problem as that which confronts us in studying the Panorpoid Orders, in which it is clear, palæontologically, that the Mecoptera were the first recent Order to be differentiated out, though they are, in some respects, more highly specialised than other Orders, which arose from the main Panorpoid stem *at later dates,* such as the Megaloptera.

The above ideas may be expressed in the Phylogenetic Diagram given herewith in Text-fig. 24. There can be no doubt that further exploration of the Ipswich Beds would yield us more valuable material in the Homoptera, and help to fill in the gaps that are only too evident in the present state of our knowledge.


PERMIAN
TRIAS
LIAS
U.JURA
CRETACEOUS
TERTIARY
RECENT
JASSIDÆ.
MEMBRACIDÆ.
CICADIDÆ.
CERCOPIDÆ.
FULGOROIDEA.
PSYLLIDÆ.
APHIDIDÆ.
COCCIDÆ.
ALEYRODIDÆ.
HETEROPTERA.
PALÆO-HEMIPTERA.
SCYTINO-PTERIDÆ.
1
2
3
4
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12

Text-fig. 24.

Text-fig.24.

Diagram showing the phylogeny of the Homoptera. There is no palaeontological evidence for the portion of the phylogenetic scheme shown by means of broken lines. The positions of important fossil types are indicated by circles, to which numbers are attached by means of arrows, as follows:—*1*, *Prosbole*; *2*, *Permofulgor*; *3*, *Scytinoptera* and *Permoscarta*; *4*, *Dunstaniidae*; *5*, *Eurymelidium*, *Mesojassus* and *Triassojassus*; *6*, *Mesoscytina*, *Mesodiphthera* and *Triassoscarta*; *7*, *Ipsvicia*; *8*, *Mesocixiinae*; *9*, *Triassopsylla*; *10*, *Archijassus*; *11*, *Procercopis*; and *12*, *Fulgoridium*.

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LETTERING OF TEXT-FIGURES.

amb, ambient vein; 1A, first anal vein; 2A, second anal vein; Cu, cubitus; Cu_1, first cubitus; Cu_{1a}, its upper, and Cu_{1b}, its lower branch; Cu_2, second cubitus or vena dividens; M, media; M_1, M_2, M_3, M_4, its branches; *mc*, median cell; R, radius; R_1 R_2, R_3, R_4, R_5, its branches; *rc*, radial cell; Sc, subcosta; Sc_1, Sc_2, its branches.

CORRIGENDA:—The following alterations need to be made in No. 6 of this series of papers (These Proceedings, xliv., 1919 Part 2, pp. 358-382, Text-figs. 29-40):—

p. 373, last line but one—*for* "*S. blabelloides*, n.sp." *read* "*S. blattelloides*, n.sp."

p. 377, line 11—*for* "SAMAROBLATTA BLABELLOIDES, n.sp." *read* "SAMAROBLATTA BLATTELLOIDES, n.sp."

p. 378, Text-fig. 37—*for* "*Samaroblatta blabelloides*, n.sp." *read* "*Samaroblatta blattelloides*, n.sp"

p. 378, last line—*for* "*Blabella* Caudell" *read* "*Blattella* Caudell."

All the above being typographical errors, Article 19 of the International Rules may be applied in the first three cases. The author therefore takes this, the first opportunity, of altering the specific name *blabelloides* to its correct form *blattelloides*.

R. J. T.